CLAIMS

1. A gas cluster ion beam detector for measuring the properties of a gas cluster ion beam comprising:

an enclosure having a first opening where the gas cluster ion beam enters the detector;

a dissociating means located within said enclosure adjacent to said first opening for dissociating gas cluster ions in the gas cluster ion beam into molecules;

a charge measuring means located within said enclosure for measuring the gas cluster ion beam current; and

a pressure measuring means located with said enclosure for measuring the pressure within said enclosure.

2. The detector of claim 1 wherein said enclosure has a second opening through which the molecules exit the detector.

3. The detector of claim 2 wherein said first opening has a conductance and said second opening has a higher conductance than said first opening.

4. The detector of claim 3 wherein said higher conductance of said second opening is at least ten times greater than the conductance of said first opening.

5. The detector of claim 1 wherein said dissociating means is a solid surface that the gas cluster ions impact.

6. The detector of claim 5 wherein said solid surface is a surface of a Faraday cup.

7. The detector of claim 1 wherein said pressure measuring means is an ionization gauge.

8. The detector of claim 1 wherein said charge measuring means is a Faraday cup.

9. The detector of claim 1 wherein the pressure inside said enclosure is higher than the pressure outside said enclosure.

10. The detector of claim 9 wherein the pressure outside said enclosure is less than one-tenth the pressure inside said enclosure.

11. The detector of claim 1 wherein the pressure measuring means comprises a temperature sensor.

12. The detector of claim 1 wherein the charge measuring means comprises:

a Faraday cup for collecting the gas cluster ion beam current, said Faraday cup having at least one bypass opening for the molecules to exit said Faraday cup and enter said pressure measuring means; and

a suppressor electrode having an electrical bias located between said first opening and said Faraday cup which promotes an accurate collection of the gas cluster ion beam current.

13. The detector of claim 12 wherein the charge measuring means further comprises a suppressor screen located between said Faraday cup and said pressure measuring means for further promoting an accurate collection of the gas cluster ion beam current.

14. A gas cluster ion beam detector for measuring the properties of a gas cluster ion beam comprising:

an enclosure having a first opening where the gas cluster ion beam enters the detector;

a current collecting region located within said enclosure adjacent to said first opening comprising means for dissociating gas cluster ions in the gas cluster ion beam into molecules and charge measuring means for measuring the gas cluster ion beam current; and

a pressure sensing region located within said enclosure having a pressure measuring means for measuring the pressure within said pressure sensing region.

15. The detector of claim 14 wherein said enclosure has a second opening adjacent to said pressure sensing region through which the molecules exit the detector.

16. The detector of claim 15 wherein said first opening has a conductance and said second opening has a higher conductance than said first opening.

17. The detector of claim 16 wherein said higher conductance of said second opening is at least ten times greater than the conductance of said first opening.

18. The detector of claim 14 wherein said dissociating means is a solid surface that the gas cluster ions impact.

19. The detector of claim 18 wherein said solid surface is a surface of a Faraday cup.

20. The detector of claim 14 wherein said pressure measuring means is an ionization gauge.

21. The detector of claim 14 wherein said charge measuring means is a Faraday cup.

22. The detector of claim 14 wherein the pressure inside said enclosure is higher than the pressure outside said enclosure.

23. The detector of claim 22 wherein the pressure outside said enclosure is less than one-tenth the pressure inside said enclosure.

24. The detector of claim 14 further comprising a temperature sensor.

25. The detector of claim 14 wherein the charge measuring means comprises:

a Faraday cup for collecting the gas cluster ion beam current, said Faraday cup having at least one bypass opening for the molecules to exit said Faraday cup and enter said pressure sensing region; and

a suppressor electrode having an electrical bias located between said first opening and said Faraday cup which promotes an accurate collection of the gas cluster ion beam current.

26. The detector of claim 25 wherein the charge measuring means further comprises a suppressor screen located between said Faraday cup and said pressure sensing region for further promoting an accurate collection of the gas cluster ion beam current.

27. A gas cluster ion beam processing system comprising:

a source for producing a gas cluster ion beam, said gas cluster ion beam comprising ionized and unionized gas clusters;

a gas cluster ion beam detector that measures the properties of said gas cluster ion beam;

means for operably controlling the relationship between said gas cluster ion beam detector and said gas cluster ion beam; and

beam switching means for selectively controlling said ionized and unionized portions of said gas cluster ion beam.

28. The processing system of claim 27 wherein said beam switching means selectively controls only said unionized gas clusters in said gas cluster ion beam into said detector.

29. The processing system of claim 27 wherein said beam switching means selectively controls only said ionized gas clusters in said gas cluster ion beam into said detector.

30. The processing system of claim 27 wherein said beam switching means selectively controls said ionized gas clusters in order for only said unionized gas clusters in said gas cluster ion beam to be directed into said detector.

31. The processing system of claim 27 wherein said means for operably controlling the relationship between said gas cluster ion beam detector and said gas cluster ion beam disposes said detector in the path of said gas cluster ion beam.

32. The processing system of claim 27 wherein said detector measures cluster size.

33. The processing system of claim 32 further comprising means for estimating a mean cluster size.

34. The processing system of claim 33 further comprising control means for adjusting parameters of the processing system based on the estimated mean cluster size.

35. A method of measuring the properties of a gas cluster ion beam comprising:

producing a gas cluster ion beam having gas cluster ions;

dissociating said gas cluster ions into molecules;

collecting the charge of said gas cluster ions;

measuring gas cluster ion beam current based upon the charge of said gas cluster ions;

detecting the pressure level associated with the dissociated molecules; and

measuring gas cluster ion beam mass based upon the pressure level associated with the dissociated molecules.

36. The method of claim 35 wherein said dissociating step is accomplished by impacting said gas cluster ions on a solid surface.

37. The method of claim 35 wherein said dissociating step is accomplished by impacting said gas cluster ions on a surface of a Faraday cup.

38. The method of claim 35 wherein said measuring gas cluster ion beam current step uses a Faraday cup.

39. The method of claim 35 wherein said measuring gas cluster ion beam current step further comprises inhibiting the collection of free electrons.

40. The method of claim 35 wherein said measuring gas cluster ion beam mass step uses an ionization gauge.

41. The method of claim 35 wherein said measuring gas cluster ion beam mass step further comprises measuring the temperature level of the dissociated molecules.

42. A method of controlling a gas cluster ion beam processing system comprising:

producing a gas cluster ion beam with ionized and unionized gas clusters;

directing said gas cluster ion beam into a detector;

measuring the properties of said gas cluster ion beam; and

adjusting parameters of said gas cluster ion beam processing system based on the measured properties.

43. The method of claim 42 wherein said directing step comprises the step of placing the detector in the path of said gas cluster ion beam.

44. The method of claim 43 wherein said directing step further comprises the step of directing only said unionized portion of said gas cluster ion beam into said detector.

45. The method of claim 44 wherein said directing step further comprises directing said ionized portion of said gas cluster ion beam away from said detector.

46. The method of claim 45 wherein the properties measured are gas cluster ion beam current and gas cluster ion beam mass.

47. The method of claim 45 wherein the properties measured further comprise gas cluster size.

48. The method of claim 45 wherein said measuring step further comprises estimating a mean cluster size.

49. The method of claim 42 wherein the properties measured are gas cluster ion beam current and gas cluster ion beam mass.

50. The method of claim 49 wherein the properties measured further comprise gas cluster size.

51. The method of claim 42 wherein said measuring step further comprises estimating a mean cluster size.